

DIVISION 400 - PAVEMENTS**SECTION 401 -- PLANT MIX PAVEMENTS - GENERAL****Description**

1.1 These specifications include general requirements that are applicable to all types of bituminous pavements of the plant mix type irrespective of the gradation of aggregate, kind and amount of bituminous material, or pavement use. Deviations from these general requirements will be indicated in the specific requirements for each type.

1.2 These specifications provide for the use of reclaimed asphalt pavement material in certain specified mixtures.

1.3 This work shall consist of the construction of one or more courses of bituminous mixture on a prepared foundation in accordance with these specifications and the specific requirements of the type of bituminous pavement under the contract, in reasonably close conformance with the lines, grades, thicknesses, and typical cross-sections shown on the plans, within the tolerances specified or established by the Engineer.

Materials

2.1 Aggregates shall be uniform quality durable pebbles or fragments of rock, with or without sand or other inert finely divided mineral aggregate. All material shall be free from clay balls, organic matter, deleterious substances, and an excess of flat or elongated pieces as specified in ASTM D 4791. Washing will not be required, except when aggregate plants do not produce clean material by the dry process method. In order to obtain uniformity of color and appearance of the pavement throughout the project, the aggregate for all the wearing courses shall be obtained from the same material source. Sufficient material shall be on hand prior to starting daily operations to ensure uninterrupted processing for the working day.

2.1.1 Coarse aggregate shall be crushed stone or crushed gravel and shall have a percentage of wear as determined by AASHTO T 96 of not more than 45 percent unless otherwise specified by contract item. In each stockpile, not less than 50 percent by weight of the particles retained on the 4.75 mm (No. 4) sieve shall have at least one fractured face. Stockpiles consisting of a blend of crushed stone and crushed gravel will be permitted so long as the overall consistency of the stockpile is reasonably maintained and the lesser portion of coarse aggregate material does not exceed 10 percent of the total. This percentage shall be determined on the portion of the total sample by weight that is retained on the 4.75 mm (No. 4) laboratory sieve.

2.1.1.1 Stockpiled coarse aggregate shall meet the requirements of Table 1.

Table 1 -- Percent Passing

Sieve Size	38 mm (1-1/2 inch)	19 mm (3/4 inch)	13 mm (1/2 inch)	10 mm (3/8 inch)
37.5 mm (1-1/2 inch)	100			
31.5 mm (1-1/4 inch)	90 - 100			
25.0 mm (1 inch)	50 - 85	100		
19.0 mm (3/4 inch)	10 - 50	90 - 100	100	
12.5 mm (1/2 inch)		15 - 55	90 - 100	100
9.5 mm (3/8 inch)			20 - 60	95 - 100
4.75 mm (# 4)				20 - 55
2.00 mm (#10)	0 - 5	0 - 5	0 - 10	0 - 10

2.1.2 Fine aggregate shall consist of sound durable particles of sand, crushed stone, or a combination thereof. Fine aggregate shall be free from clay balls and injurious amounts of organic matter. Stone screening shall be produced from stone at least equal in quality to that specified for coarse aggregate. Fine aggregate may be 100 percent manufactured aggregate for base courses and shall consist of at least 25 percent natural sand for wearing courses. If workability problems occur additional natural sand may be required. Fine aggregate stockpiles containing aggregate larger than 9.5 mm (3/8 in) shall not be used.

2.1.3 Mineral filler shall conform to AASHTO M 17.

2.1.4 Gradation. Coarse and fine aggregate shall each be of such gradation that, when combined with other required aggregate fractions in proper proportion, the resultant mixture will meet the gradation required under the composition of mixture for the specific type under contract. (See Table 2.) Not more than 10 percent of the fine aggregate blend shall pass the 0.075 mm (No. 200) sieve. Grading of mineral filler shall conform to the required grading of AASHTO M 17 except that 100 percent shall pass the 0.850 mm (No. 20) sieve, waiving the requirement for the 0.600 mm (No. 30) sieve.

2.2 Bituminous materials used for asphalt cement binder shall meet the properties specified in AASHTO M 320. The grade of asphalt cement binder to be used will be specified in a Special Provision contained in the Proposal.

2.2.1 Approved sampling valves shall be installed in transport tank trucks to permit taking representative samples of the contents. The recommended location of the sampling valve is in the rear bulkhead of the tank, roughly one-third of the height above the bottom. The inlet pipe shall project into the contained liquid as shown in AASHTO T 40.

2.3 Approval of materials. At least three working days in advance of the date of starting operations, representative samples of all materials proposed for use shall be submitted to the Engineer for test and for the preparation of trial mixes relating to the job mix formula. No material shall be used until it has been approved.

2.4 Composition of mixtures. The bituminous plant mix shall be composed of a mixture of aggregate, filler if required, and bituminous material. The several aggregate fractions shall be sized, uniformly graded, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula.

2.4.1 Job mix. The general composition limits given in Table 2 indicate the master range of mixtures permissible under this specification. No work shall be started on a paving project until the Engineer approves a job mix formula appropriate to the raw materials and blends available to the specific project. The job mix formula shall lie within the master range indicated for the particular type of bituminous concrete. The job mix formula for each mixture shall establish a single percentage of aggregate passing each required sieve size, a single percentage of bituminous material to be added to the aggregate, and a single temperature at which the mixture is to be delivered at the point of discharge. This temperature is subject to change as ordered, depending upon the conditions of the day. Gradings that range from the maximum of one sieve to the minimum of the next will not be permitted. The job mix formula for each mixture shall be in effect until modified in writing by the Engineer. The Administrator of the Bureau of Materials and Research may require the use of certain chemical additives.

2.4.1.1 After the job mix formula is established, all mixtures furnished for the project shall conform within the following ranges of tolerances:

Passing 4.75 mm (No. 4) and larger sieves	±7 percent
Passing 2.00 mm (No. 10) to 0.180 mm (No. 80) sieves (inclusive)	±4 percent
Passing 0.075 mm (No. 200) sieve	±2 percent
Bitumen	±0.4 percent
Temperature of mixture	±11 °C (20 °F)

2.4.1.2 Should a change in sources of material be made, a new job mix formula shall be established before the new material is used. When unsatisfactory results or other conditions make it necessary, the Engineer may establish a new job mix formula.

2.4.1.3 The quantity of asphalt cement is given in terms of percent by weight of the total mixture. The amount of asphalt required for a given mixture should be determined by appropriate laboratory testing or on the basis of past experience with similar mixtures, or by a combination of both.

2.5 Bridge pavement base course shall be Type F Wearing Course.

2.6 Non-modified asphalt cement shall contain silicone additive with the concentration being 3 parts per million plus or minus 1 part per million of silicone to asphalt cement, unless otherwise directed. Silicone additive shall be in liquid form and have a viscosity of 1 Pa•s (1,000 centipoises) at 25 °C (77 °F). Asphalt cement containing silicone shall meet the requirements of 401.2.2.

Table 2 - Composition of Mixtures – Master Ranges⁽¹⁾

Sieve Size		Base Courses ⁽²⁾									Wearing Courses								
		Type A: ⁽⁴⁾ 31.5 mm (1-1/4 in)			Type B: ⁽⁴⁾ 19 mm (3/4 in)			Type C: ⁽⁴⁾ 12.5 mm (1/2 in)			Type D: ⁽⁴⁾ 19 mm (3/4 in) Single Course			Type E: ⁽⁴⁾ 12.5 mm (1/2 in)			Type F: ⁽⁴⁾ 9.5 mm (3/8 in)		
		Percentage by Weight Passing - Combined Aggregate																	
		Min	Desired	Max	Min	Desired	Max	Min	Desired	Max	Min	Desired	Max	Min	Desired	Max	Min	Desired	Max
31.5 mm (1-1/4 in)		95	100	100															
25.0 mm (1 in)		75	85	95															
19.0 mm (3/4 in)		62	72	84	95	100	100				95	100	100						
12.5 mm (1/2 in)		50	60	70	70	81	92	95	100	100	82	91	100	95	100	100			
9.5 mm (3/8 in)		42	50	60	60	71	80	65	75	85	68	79	90	85	90	95	95	100	100
4.75 mm (No. 4)		28	36	45	42	50	57	38	44	50	50	65	79	60	66	75	64	71	80
2.36 mm (No. 8)		19	24	30	30	34	41	30	34	39	38	53	67	40	48	52	46	53	59
1.18 mm (No. 16)		13	17	21	20	24	29	21	25	29	29	41	58	29	34	38	31	37	42
0.600 mm (No. 30)		7	12	15	12	16	20	13	16	20	25	32	45	20	24	28	20	25	30
0.300 mm (No. 50)		3	7	11	6	10	14	6	10	14	14	24	35	10	15	19	12	17	22
0.150 mm (No. 100)		1	4	6	2	5	8	2	5	8	6	12	20	4	7	10	5	9	13
0.075 mm (No. 200)		0	2	4	0	3	4	0	3	4	3	5	8	2	3	6	2	4	6
Asphalt Cement: % of Mix ⁽³⁾		3.8	4.3	4.8	4.8	5.25	6.0	5.0	5.4	5.8	5.5	6.0	6.5	6.0	6.4	7.0	6.25	6.5	7.0

- (2) Alternate aggregate sizes are included to ensure that the coarse aggregate shall not be larger than one-half the thickness of the layer being placed.
- (3) The asphalt content for the above mixture is based on the use of aggregate with a specific gravity of 2.65 to 2.70. The asphalt content will be adjusted when aggregate with a higher specific gravity is used.
- (4) Reclaimed asphalt pavement is permitted.

2.7 Reclaimed Asphalt Pavement (RAP). RAP shall consist of asphalt pavement and shall be processed by crushing, cold milling, or other approved sizing techniques approved by the Bureau of Materials and Research to meet the required gradation specifications. The mixture of RAP, new aggregate, and added asphalt cement shall meet the requirements specified in Table 2 for aggregate gradation and asphalt cement content. The added asphalt cement may be AC 5, AC 10, or other asphalt cement grades as designated by the Bureau of Materials and Research. The aggregate component of the RAP shall meet the requirements of Section 401.2.1. The bitumen component of the RAP shall be asphalt cement and shall be free of significant contents of solvents, tars, and other volatile organic compounds or foreign substances that will make the RAP unacceptable for recycling as determined by the Bureau of Materials and Research. The blend percentage of RAP for a drum mixer shall not exceed 50 percent and for a batch plant shall not exceed 35 percent. RAP incorporated in wearing courses for both a drum mixer and a batch plant shall not exceed 15 percent. The Bureau of Materials and Research will use one of the following procedures to approve the RAP quality.

(a) RAP obtained from a pavement that was constructed with asphalt cement and aggregates that meet the current requirements of Section 401.2.1 will be approved by the Bureau of Materials and Research.

(b) If the source of RAP is unknown, but is of acceptable quality as described above, it will be allowed to a maximum of 15% of the total batch weight. No more than two design percentages will be considered for any mix design containing rap.. RAP materials from unknown sources may be rejected if deemed unsuitable for any reason or require an increase or decrease in the mix asphalt content. The Contractor shall submit for approval to the Bureau of Materials and Research at least 30 calendar days prior to the start of paving the following:

1. The designated use of the RAP and approximate proportions.
2. Representative samples and gradation and asphalt cement content test results of the RAP to be incorporated into the Recycled Mixture. One sample shall be taken from each 900 metric tons (1,000 tons) or less of the stockpiled material, as the stockpiles are being built.

2.8 Asphalt modifiers. Admixtures and additives may be approved by the Administrator of the Bureau of Materials and Research Construction Requirements.

3.1 Mixing Plants.

3.1.1 The site shall have ample storage space for the required separate bins, stalls, or stockpiles to allow delivery of uncontaminated sized aggregates to the feeder. To prevent spillage from one pile or bin to the next, aggregate assigned to different stockpiles shall be separated by bulkheads or other satisfactory means, and buckets on equipment used to fill bins or stalls shall not be wider than the clear opening of the bin.

3.1.1.1 Course aggregates shall be furnished in at least two nominal sizes for mix types containing top size aggregates of 12.5 mm (1/2 in) and larger.

3.1.1.2 Stockpiles of coarse aggregate produced for use in drum mix plants having top size aggregates greater than 19 mm (3/4 in) shall be constructed in layers not to exceed 1.2 m (4 ft).

3.1.1.3 RAP shall be stockpiled on a free draining base separately from other aggregates. RAP from each pavement source shall be stockpiled with RAP materials having similar characteristics. RAP taken from Type A pavement courses shall be stockpiled separately. RAP shall be reclaimed from stockpiles without contamination by foreign materials.

3.1.1.4 RAP shall be fed into the plant by equipment specifically designed for recycling and approved by the Bureau of Materials and Research. In addition, all requirements pertaining to aggregates shall apply to RAP. Scalping screens, grizzlies, or similar devices shall be installed on the RAP feed bin(s) to remove any debris or other foreign materials in excess of 100 mm (4 in). If a drum mix plant is used, the RAP shall be fed into the drum so that it will not come in direct contact with the burner flame. Mixing of RAP with the new aggregate shall occur before the bituminous material introduction point. The final mix produced shall be visually free from any chunks of RAP.

3.1.1.5 All blending of aggregates shall be accomplished through separate bins at the cold elevator feeders and not in stockpiles.

3.1.1.6 The plant shall be provided with a dust collector or collectors, designed to waste or return uniformly to the hot elevator all or part of the material collected, as directed. All plants shall have adequate covers and housing as may be necessary to ensure the proper collection of dust and the general cleanliness of the plant operation. The Contractor shall comply with all State and Federal environmental regulations.

3.1.1.7 Plants shall be approved prior to operations and shall be operated so as to ensure an adequate supply of mixture to the project.

3.1.2 Safety Requirements for Inspection.

3.1.2.1 Adequate and safe stairways to the mixer platform shall be provided, and guarded ladders to other plant units shall be located where required for accessibility to plant operations.

3.1.2.2 All gears, pulleys, chains, sprockets, and other dangerous moving parts shall be thoroughly guarded and protected.

3.1.2.3 Ample and unobstructed space shall be provided on the mixing platform. The plant operator shall have a clear and unobstructed view of the plant operations.

3.1.2.4 A clear and unobstructed passage shall be maintained at all times in and around the truck loading space. This space shall be kept free of drippings from the mixing platform. A ladder or platform shall be so located at the truck loading space to permit easy and safe inspection of the mixture as it is delivered into the trucks. Adequate overhead protection shall be provided where necessary. In addition, a platform shall be located in close proximity to the inspector's laboratory for the purpose of easily obtaining samples of the mixture from the trucks.

3.1.2.5 When the plant is to be operated in other than daylight hours, adequate lighting shall be provided in all areas frequented by the inspector during his normal routine. Specific areas to be illuminated include the truck loading zone and the aggregate feeder locations. A light or lights shall also be located so as to allow the clear observance of the truck body lubrication operation.

3.1.3 Inspection Facilities.

3.1.3.1 The Contractor shall notify the Bureau of Materials and Research at least three working days in advance of starting paving operations to allow sufficient time to schedule required plant inspection personnel. When paving bridge decks that have barrier membranes, this notice shall include the name of the membrane product so that the mix temperature may be established.

3.1.3.2 The Engineer will have access at all times to all parts of the plant for inspection of the conditions and operations of the plant, for confirmation of the adequacy of the equipment in use, for verification of proportions and character of materials, and for determination of temperatures being maintained in the preparation of the mixtures. The Contractor shall provide a suitable building, room, or trailer for exclusive use as a field laboratory, in which to house and use the testing equipment. Laboratories shall be in an approved location with the plant operation visible from one window. Unless otherwise approved, one laboratory shall be provided for each plant.

3.1.3.3 Field laboratories shall meet the following minimum requirements:

Outside Dimensions: 4.8 m long by 2.4 m wide by 2.1 m high (16 ft long by 8 ft wide [or equal], by 7 ft high).

Windows: Two, with locks and screens, providing cross ventilation.

Doors: One, with lock and screen.

Electrical: Adequate lighting and power outlets.

Air Conditioner: Unit size shall be as recommended for size of the facility.

Heat: Thermostatically controlled to maintain a minimum temperature of 20 °C (68 °F).

Weatherproofing: Roof, sides, and floor shall be maintained weatherproof at all times.

Appurtenances: (a) An exhaust fan and hood over hot plates and extractor. The hood shall be large enough to cover both the hot plates and the extractor; the fan shall be a high-volume axial-flow fan, at least 250 mm (10 in) in diameter, and of sufficient capacity to adequately vent the fumes.

(b) Free wallspace of at least 1 m² (12 ft²); or a bulletin board of equal area for posting notices and job mix formulas.

(c) Suitable shelves and benches. One bench shall be approximately 600 mm wide by 900 mm high and at least 3 m long (24 in wide by 36 in high and at least 10 ft long). The bench may extend the length of the building.

(d) Ovens used to heat asphalt shall be located under the exhaust hood or vented to the outside to adequately vent fumes.

3.1.3.4 The following office furnishings and testing equipment shall be provided:

(a) Electronic balance with tray, at least 9000 gram (300 oz) net capacity, sensitive to 0.1 gram (0.003 oz).

(b) Desk and chair.

(c) Set of U.S. Standard brass sieves, each sieve being 300 mm (12 in.) in diameter and 37.5 mm (1-1/2 in.) high. The set shall consist of one each of the following sizes: 37.5 mm, 31.5 mm, 25.0 mm, 19.0 mm, 12.5 mm, 9.5 mm, 4.75 mm, 2.36 mm, 1.18 mm, .600 mm, .300 mm, .150 mm, .075 mm, (1-1/2 in., 1-1/4 in., 1 in., 3/4 in., 1/2 in., 3/8 in., No. 4, No. 8, No. 16, No. 30, No. 50, No. 100, No. 200), with pan and cover.

(d) Motor driven shaker for 300 mm (12 in.) diameter sieves. Shaker shall meet the following requirements: Rotating turntable, tilt to 45 degree angle and have hammers to tap each sieve during operation.

(e) Double burner hot plate or gas stove.

(f) Motor driven centrifuge extractor, 3000 gram (100 oz) capacity with variable speed up to 3600 rpm, with filter rings and non-toxic solvent approved by the Bureau of Materials and Research.

(g) Tachometer readily available to check the speed of the extractor.

(h) Compaction pedestal meeting the requirements of AASHTO T 245, Section 2.4, complete with Marshall mold holder, mechanically operated compaction hammer, and two molds.

(i) Automatic timer with interval of 0 to 30 minutes.

(j) Bristle brush for cleaning 0.075 mm (No. 200) sieve.

(k) Brass brush for cleaning 200 mm (8 in) diameter sieves.

(l) Five pans, approximately 50 mm (2 in) high, 250 mm (10 in) round or square.

(m) Spatula, large spoon, garden trowel, measuring scoop, and 1 L (1 quart) pitcher.

(n) Fire extinguisher, minimum 2.3 kg (five pound) dry chemical.

(o) Long-handled square blade shovel.

(p) Desk brush and floor broom.

(q) Sample splitter (riffle type), chute width 38 to 50 mm (1-1/2 to 2 in).

(r) Microwave oven when drum mix plant is used.

(s) Minimum of one metal sample pail for each hot bin.

(t) Minimum of two pails for Marshall test.

(u) Lavatory with toilet (See 698.2.2.4) and wash basin, unless approved otherwise.

(v) Water, hot and cold, and water suitable for drinking. (Fountain style will be acceptable).

(w) Telephone with private line.

(x) Drying oven, minimum of 0.10 m³ (3.5 ft³).

(y) All ovens other than microwaves shall be vented to the outside.

3.1.3.5 All of the foregoing testing equipment shall be in good condition and shall be replaced or repaired by the Contractor if, during the duration of the project, it becomes unsuitable for testing purposes. Testing equipment shall be calibrated by the Contractor in accordance with 106.03. The above mentioned equipment is for a one plant operation only.

3.1.4 Storage of Bitumen.

3.1.4.1 Tanks for storage of bitumen shall be of minimum 38 000 L (10,000 gal) capacity and equipped for heating the material under effective and positive control at all times, to the temperature requirements set forth in the specifications for the paving mixture. Heating shall be accomplished by steam or oil coils, electricity, or other means such that no flame shall come in contact with the heating tank.

3.1.4.2 A complete system providing for continuous circulation of the bitumen between the storage tank and the proportioning units shall be employed. The discharge end of the circulating pipe shall be maintained below the surface of the bitumen in the storage tank to prevent discharging the hot bitumen into the open air.

3.1.4.3 The Contractor shall provide in the bitumen feed lines connecting the plant storage tanks to the bitumen weighting system or spray bar a sampling outlet consisting of a valve installed in such a manner that samples may be withdrawn from the line slowly at any time during plant operation. The sampling outlet shall be installed between the pump and the return discharge line in such a location that it is readily accessible and free from obstruction. A drainage receptacle shall be provided for flushing the outlet prior to sampling.

3.1.5 Control of Bitumen.

3.1.5.1 Satisfactory means either by weighing or metering shall be provided to obtain the proper amount of bituminous material in the mix within the tolerance specified. Means shall be provided for checking the quantity or rate of flow of bituminous material into the mixer as follows:

(a) Metering devices for bitumen shall indicate accurately to within 1.0 percent the amount of bitumen delivered. The section of the bitumen flow line between the charging valve and the spray bar shall be provided with a three-way valve and outlet whereby the quantity delivered by the meter may be checked by actual weight. The valve controlling the flow of bitumen to the mixer shall close tightly to prevent bitumen from leaking into the pug mill during the mixing cycle. The meter shall be constructed so that it may be locked at any dial setting to 0.4 L (0.1 gal) and will automatically reset to this reading after the addition of bitumen to each batch. The dial shall be in full view of the mixer operator. The size and spacing of the spray bar openings shall provide a uniform application of bitumen the full length of the mixer in a thin uniform sheet or in multiple sprays.

(b) If a bucket is used for weighing the bitumen, the bucket shall be of sufficient capacity to hold and weigh the amount required for a batch in a single weighing. The filling system and bucket shall be of such design, size, and shape that bitumen will not overflow, splash, or spill outside the confines of the bucket during filling and weighing. The filling system and bucket shall be so arranged as to deliver the bitumen in a thin uniform sheet or in multiple sprays over

the full length of the mixer. The time required to add the bitumen shall be not more than 15 seconds.

(c) Bitumen scales shall conform to the requirements for aggregate scales as specified in 3.1.6.7. Beam type scales shall be equipped with a tare beam or adequate counter-balance for balancing the bucket and compensating periodically for the accumulation of bitumen on the bucket.

3.1.5.2 Suitable means shall be provided, either by steam or oil jacketing or insulation, for maintaining the specified temperatures of the bitumen in the pipelines, meters, weigh buckets, spray bars, and other containers or flow line.

3.1.6 Batching Plants.

3.1.6.1 Feeders shall provide an accurate and positive means for uniform and continuous feeding of coarse aggregate to the dryer. Fine aggregate material shall be delivered by belt driven feeders for uniform control of material. All feeders shall provide for adjustment of the cold feed and shall be capable of being secured in any position.

3.1.6.2 Dryers shall continuously agitate the aggregate during the heating and drying process without leaving any visible unburned oily residue on the aggregate when it is discharged from the dryer. If unusually wet aggregate is being used, the input to the dryer shall be reduced to that amount which the dryer is capable of drying. Aggregates shall be free from coatings of dust after drying.

3.1.6.3 Plant screens shall be constructed and operated in such manner that all aggregates will be uniformly separated into the sizes required for proportioning. They shall have sufficient capacity to furnish the necessary quantity of each aggregate size required for continuous operation. Screen cloth that has become broken or has worn sufficiently to affect the gradation shall be replaced.

3.1.6.4 Thermometric equipment shall be provided as follows:

(a) An armored thermometer of suitable range shall be fixed in the bitumen feed line at a suitable location near the discharge at the mixer unit.

(b) The plant shall be further equipped with an approved thermometer, pyrometer, or other approved thermometric instrument that continuously indicates the temperature of the heated aggregate at the discharge chute of the dryer.

3.1.6.5 Hot bins shall consist of at least four separate aggregate compartments. One compartment shall be reserved for aggregate not larger than that passing a 4 mm (5/32 in) square opening screen, and when required, one additional compartment shall be added for dry storage of mineral filler. Provision shall be made for accurate proportioning. When a compartment contains more than 15 percent undersized material, the compartment shall be drawn, and the cause of the contamination shall be corrected. Each compartment shall contain the following features:

- (a) Sufficient volume to supply the mixer at full rated capacity.
- (b) An overflow pipe that shall be of such size and at such a location as to prevent any backing up of material into other bins or into contact with the screen. Overflow apparatus shall

be equipped with a telltale device that alerts the operator and the inspector when the overflow equipment is full.

- (c) Adequate telltale devices to indicate the position of the aggregate in the bins at the lower quarter points.
- (d) Gates that cut off quickly and completely with no leakage.
- (e) Adequate and convenient facilities including safe platforms for obtaining representative samples from each bin.

3.1.6.6 Weigh boxes shall be of sufficient size to hold the maximum required weight of aggregate for one batch without hand raking or running over. The weigh box shall be supported on fulcrums and knife edges so constructed that they remain in alignment or adjustment. All parts of the weigh box shall be free from contact with any supporting rods, columns, or other equipment that affects the proper functioning of the hopper or scale. Gates on both bins and weigh hopper shall be constructed to prevent leakage when closed.

3.1.6.7 Aggregate scales for any weigh box or hopper shall be of standard make and design and shall be accurate to 0.5 percent of the indicated load. The weight shall be indicated on a springless dial or digital display. Scales shall be substantially constructed and shall be installed in such a manner as to be free from vibration. The dial shall be of the compounding type and have a full set of pointers to indicate the job mix formula. All dials shall be located so as to be plainly visible to the operator at all times and shall be of such a size that the numerals can be read at a distance of 8 m (25 ft). When a digital display system is used, the display shall be in full view of the operator, and the numerals shall be of such a size that they can be easily read by the inspector. If the digital display is so located that it is not easily accessible to the inspector, a duplicate display will be required for exclusive viewing by the inspector. The job mix formula target weights shall continuously be part of the digital display during plant operations. The digital scale weight indications shall be displayed adjacent (in juxtaposition) to each target weight for easy comparison to the job mix formula. It shall be the responsibility of the Contractor to ensure that all scales are tested and sealed according to provisions as shown in the National Institute of Standards and Technology Handbook 44, at least on an annual basis. The work shall be accomplished by a competent commercial scale company prior to the start of the construction season. Scales shall be re-tested prior to use, after they have been moved. The Contractor shall have readily available at least eleven standard 20 kg, one standard 5 kg, and two standard 1 kg (ten standard 50 lb) weights, for checking the scales during operations.

3.1.6.8 The batch mixer shall be of an approved pug mill type, hot oil or steam jacketed, or heated by other approved means and capable of producing uniform mixtures within the specified tolerances. The mixer shall have a batch capacity of not less than 900 kg (2,000 lb) and be constructed so as to prevent leakage during the mixing cycle. The amount of material that may be mixed per batch shall not exceed the manufacturer's rated capacity. If the mixer does not mix properly at the rated capacity, or if its production does not coordinate with the other plant units, the Department reserves the right to reduce the size of the batch until the desired efficiency is obtained. The pug mill shall be equipped with a sufficient number of paddles operated at such speed as to produce a properly and uniformly mixed batch. If, in the course of mixing, two adjacent paddle tips become broken, immediate repair will be called for. If the paddle tips become broken at widely separated points, repair may be delayed until the end of the working day. The clearance of the tips from all fixed and moving parts shall not exceed 19 mm (3/4 in). Badly worn or defective tips shall not be used in mixing operations. The mixer shall be covered

to prevent loss of fine material. The discharge gate shall be so designed that no uncoated material is retained at the gate opening during the mixing operation. Leakage from the pug mill gate during operation will not be permitted.

3.1.6.9 Each plant shall be equipped with an accurate time lock to control the operations of a complete mixing cycle. A mixing cycle shall consist of two periods, the dry mixing period and the wet mixing period. The dry mixing period shall be the interval of time between the opening of the aggregate weigh hopper gate and the start of the application of bitumen. The wet mixing period shall be the interval of time between the start of the application of bitumen and the opening of the mixer gate. The time lock shall be capable of being set at the intervals of five seconds or less throughout the mixing cycle and shall have a suitable case equipped with an approved lock. The setting of time intervals shall be performed in the presence and under the direction of the Engineer who may lock the case until such time as a change is to be made in timing periods. The time lock shall lock the bitumen bucket throughout the dry mixing period and shall lock the mixer gate throughout the dry and wet mixing period. Lights meeting the approval of the Engineer and visible from the ground shall indicate when each portion of the mixing cycle is occurring.

3.1.6.10 The use of a fully automatic batching plant may be approved, provided the systems for automatic batching and proportioning of the various components of the bituminous mixtures meet the following requirements:

(a) The automatic proportioning controls shall include equipment for accurately proportioning batches of the various components of the mixture by weight in the specified sequence and for controlling and timing the mixing operation. Interlocks shall be provided that delay, stop, or lock out the automatic batch cycling whenever the batched quantity of any component weight or the total batch is not within the specified weight tolerance, or when there is a malfunction in any portion of the control system. The automatic batching or proportioning controls shall be equipped with lights meeting the approval of the Engineer and visible from the ground and shall indicate when each portion of the mixing cycle is occurring.

(b) The automatic control for each batching scale system shall be equipped with a device for stopping the automatic cycle in the underweight check position and in the overweight check position for each material so that the tolerance setting may be checked.

(c) Each dial scale system shall be equipped with a removable dial puller that can be attached to the dial lever system so that the dial can be moved smoothly and slowly through its range to check the settings of the automatic control system. The plant operator shall perform this automatic control system checkout procedure periodically as requested by the Engineer.

(d) The weigh batching controls shall meet the following tolerances for the various components weighed in each batch:

Component Weighed	Percentage of Total Batch Weight
Tare weight of aggregate weigh box	±0.5
Tare weight of bitumen weigh bucket	±0.1
Each aggregate component	±1.5
Mineral filler	±0.5
Asphalt	±0.1

(e) The total weight of the batch shall not vary by more than ± 2.0 percent of the designated batch weight.

(f) Recording equipment shall be provided in all plants employing automatic proportioning. Each recorder shall include an automatic printer system. The printer shall be positioned so that the scale reading and the printer can be readily observed from one location by the plant inspector. The printer shall produce, in digital form, a weight slip conforming to the requirement of 109.01 and 401.3.4.4.

(g) If at anytime the automatic proportioning or recording system becomes inoperative, the plant will be allowed to batch materials manually, but will be required to use the timing and time lock devices, for a period not to exceed two working days. Approval will be dependent upon the Contractor's furnishing an alternate satisfactory method of determining the total weight of material delivered to the project. Time extensions greater than two working days will require written permission.

3.1.6.11 The aggregate shall be dried and heated to a minimum temperature of 125 °C (260 °F). The bitumen shall be heated to a temperature between 120 and 165 °C (250 and 325 °F). Each size of hot aggregate, the mineral filler if required, and the bituminous cement shall be measured separately and accurately to the proportions in which they are to be mixed. The mixture shall be made by charging the mixer with the hot aggregate, coarse sizes first, unless otherwise directed, which shall be dry mixed for 5 to 15 seconds. The bitumen shall be added and the mixing continued until a uniform coating is obtained and all particles of the aggregate are thoroughly coated. The total dry and wet cycle shall be not less than 35 seconds for base and binder mixtures and not less than 45 seconds for the wearing course. In no case shall the total mixing period exceed 75 seconds.

3.1.6.12 If the aggregate in the hot bins contains sufficient moisture to cause foaming in the mixture, such aggregate shall be removed from the bins, and production rate shall be reduced so as not to exceed the capacity of the dryer. Material having once gone through the mixing plant shall not be returned to the stockpiles.

3.1.7 Drum Mix Plants.

3.1.7.1 The plant shall be specifically designed for the process and shall be capable of satisfactorily heating, drying, and uniformly mixing the bituminous material and aggregate in accordance with the job mix formula. The rate of flow through the drum shall be controlled in order that a homogeneous mixture is obtained with all particles uniformly coated. In no case shall the quantity of mix produced exceed the manufacturer's rated capacity. If the percent of moisture in the mixture exceeds 1.0 percent by weight, the right is reserved to decrease the rate of production. The plant shall be equipped with automatic burner controls.

3.1.7.2 The cold bins shall be divided in at least four compartments and shall be designed to prevent the overflow of material from one bin to another. When reclaimed pavement is used, an additional bin designed for this purpose will be required. Each cold bin shall be equipped with an orifice to feed the aggregate accurately and uniformly. The feeding orifice shall be adjustable, and indicators shall be provided to show the gate opening. An automatic plant shutoff device shall be provided to operate when any aggregate bin becomes empty or the flow from any bin gate becomes restricted. A vibrator or other suitable means may be required in order to ensure a uniform flow of materials. The order of aggregate feed onto the composite cold

feed belt shall be from coarse to fine. A scalping screen mounted independently of other proportioning or weighing equipment will be required.

3.1.7.3 The total cold aggregate feed shall be weighed continuously by an approved belt scale. The weighing system shall register within +0.5 percent of the indicated load.

3.1.7.4 An automatic aggregate sampling device shall be provided that diverts representative samples of the full flow of aggregate from the total cold feed. The sampling device shall cut the full width and depth of the aggregate flow. The sampling point shall be after the aggregate has passed through the scalping screen and prior to entry into the drum.

3.1.7.5 Proportioning controls for aggregate and bitumen shall be located at the panel that also controls the mixture and the temperature. The panel shall be equipped with automatic controls that shall display, in digital form, the percentages of bitumen, mineral filler if required, and each aggregate in the job mix formula. The panel shall also be equipped to raise and lower the production rate without having to reset the individual controls for each change in production rate. The controls shall maintain an aggregate flow accuracy such that the total variation of all materials being drawn per interval of time shall not exceed an amount equal to 1.5 percent of the total weight of bituminous mixture per interval of time.

3.1.7.6 Provisions shall be made for introducing the moisture content of the total cold feed into the belt weighing system and correcting the wet aggregate weight to dry aggregate weight. The system shall be capable of adjusting the flow of bituminous material to compensate for any variation in the dry weight of the aggregate flow. It shall be the responsibility of the Contractor to monitor and determine accurate moisture contents of the aggregate and RAP stockpiles used for production of hot mixed asphalt. The actual moisture content of the aggregate and RAP stockpiles shall be used for mix production. The moisture content shall be adjusted by the Contractor as variations in the stockpile moisture content occur.

3.1.7.7 The dry weight of the aggregate flow shall be displayed by automatic digital readout in units of weight per interval of time.

3.1.7.8 When mineral filler is specified, a separate bin and feeder shall be provided with a variable drive interlocked with the aggregate feeders. Mineral filler shall be introduced and uniformly dispersed into the mixture without loss to the dust collection system. A device shall be provided to indicate when the flow of filler into the delivery system stops or its specified volume is out of job mix tolerance. The rate of flow shall be accurate to within 0.5 percent by weight, of the total mix. Means shall be provided to readily divert the flow of mineral filler into a container for measurement.

3.1.7.9 The bitumen shall be introduced through a continuously registering cumulative indicating meter by a pump specifically designed for the plant. The meter shall be located in the asphalt line so that it continuously registers the asphalt discharge to the mixer and so that the discharge through the meter can be readily diverted into a suitable container for measurement by actual weight. The meter shall indicate accurately to within 1.0 percent the amount of bitumen being delivered. The accuracy of the pump and meter shall be verified at periodic intervals as designated by the Engineer.

3.1.7.10 Satisfactory means shall be provided to ensure positive interlock between dry weight of aggregate flow and the flow of bituminous material through an approved meter.

3.1.7.11 The flow of bituminous material shall be displayed by automatic digital readouts in terms of volume or intervals of weight and time.

3.1.7.12 The plant shall have a means of diverting mixes at start up and shut down or where mixing is not complete or uniform.

3.1.7.13 A surge or storage system complying with 3.3 shall be provided.

3.2 Mixing Temperature.

3.2.1 The Engineer may adjust the job mix formula temperature within the limits of 125 and 180 °C (260 and 350 °F) according to the existing conditions. During hot weather, the temperature of the mixture when discharged shall be as low as is consistent with proper mixing and placing. During cold weather, a temperature approaching the upper limit is desirable. Material with a temperature at discharge outside the job mix formula tolerance may be rejected. In no case will a mixture be accepted with a discharge temperature in excess of 190 °C (375 °F).

3.3 Hot Storage System.

3.3.1 The hot storage system shall be capable of conveying the hot mix from the plant to insulated and enclosed storage bins and storing the hot mix without appreciable loss in temperature, asphalt migration, segregation, or oxidation.

3.3.2 The conveyer system may be a continuous type or skip bucket type. If the continuous type is used, it shall be enclosed to prevent a drop in mix temperature. If the skip bucket type is used, the bucket must be of sufficient capacity to transport an entire batch and mass dump it into the bins.

3.3.3 The storage bins shall be designed in such a manner as to prevent segregation of the hot mix during discharge from the conveyor into the bins and shall be equipped with discharge gates that do not cause segregation of the hot mix while loading the mix into the trucks. The storage bin heating system shall be capable of maintaining the mix temperature without localized heating (hot spots).

3.3.4 The bin shall be equipped with a light or indicator to show when the level of material reaches the top of the discharge cone. The bin shall not be emptied below the top of the discharge cone until the use of the bin is completed each day. The material remaining in the discharge cone may be rejected if there is evidence of segregation.

3.3.5 Unless otherwise permitted, material placed in a surge bin or storage silo must be used during the same working day. When such permission is given in an emergency, material remaining overnight must be used within 24 hours of the time of mixing.

3.3.5.1 Extended storage silos designed for long term storage may receive prior approval for routine overnight storage provided that the mix is to be used on the following day. For this work, the Contractor must provide certified test results for each silo that the following

acceptance criteria for mix quality are met. These test results and certifications must be obtained from an approved testing company and submitted to the Bureau of Materials and Research. When an emergency arises such as an extended rainy period or equipment failure, the Engineer may grant additional storage time up to 72 hours provided that the bin has been certified for the extended period. When the extended period has been granted, the bin shall be sealed off from the entrance of air and shall not be opened for any reason until the project is ready for the entire contents of the bin. Violation of this provision will void the certificate, and the contents of the bin will be rejected. The mixtures, after storage, shall meet the following criteria:

<u>Test Property</u>	<u>Allowable Variation</u>
1. Temperature	$\pm 10^{\circ}\text{C}$ ($\pm 20^{\circ}\text{F}$) from plant discharge temperature.
2. Asphalt Cement Recovered from Wearing Course Mixture	
a. Penetration at 25°C (77°F)	Loss not to exceed 50 percent of the penetration of the asphalt sampled from the plant prior to mixing at 143°C (290°F).
b. Viscosity at 60°C (140°F)	Viscosity not to exceed four times the viscosity of the original asphalt sampled from the plant prior to mixing at 143°C (290°F).

3.3.6 The storage time will be defined as the interval of time beginning with the introduction of the mixture into the bin to the time of the completion of discharge from the bin.

3.3.7 Approval for the use of storage bins may be withdrawn in the event that there is an excessive amount of heat loss, segregation, or oxidation of the hot mix due to the use of storage bins.

3.4 Weighing and Hauling.

3.4.1 Truck scales shall be provided for non-automated plants and storage without scales. These scales shall be tested and sealed according to provisions as shown in the National Institute of Standards and Technology Handbook 44 annually by a competent commercial scale company. Each truck shall be tared daily prior to the day's operations by a certified weigh master and shall be properly logged. The sealing of scales and provisions for random weighing of truck loads for all automated and non-automated plants shall be the responsibility of the Contractor. Portable scales shall be checked after moving and before being used.

3.4.2 The weight of each truckload of paving mixture, as indicated by the truck scales, shall be within ± 3 percent of the total weight of all batches in the load. Failure to maintain this standard of uniformity shall be sufficient cause for stopping plant operations until the cause of such disparity in weight is corrected.

3.4.2.1 The Contractor may provide an approved printer system that prints the weights of the material delivered. Such weights shall be evidenced by a weight slip for each load.

3.4.3 The Contractor may provide an approved automatic printer system that prints the weights of the material delivered, provided the system is used in conjunction with an approved automatic batching and mixing control system. Such weights shall be evidenced by a weight slip for each load.

3.4.4 Weight slips shall include requirements as shown in 109.01 and the following for batch plants with automatic porportioning equipment:

- (a) Tare weight of aggregate weigh box.
- (b) Tare weight of bitumen weigh bucket.
- (c) Accumulative weights as batched for each aggregate (total of last aggregate will be aggregate total).
- (d) Weight of bitumen.
- (e) Accumulated total weight of batch.

3.4.5 Each weight slip will show a consecutive load number and shall include an accumulative total of material delivered for each day.

3.4.6 The mixture shall be transported from the paving plant to the project in trucks having tight, smooth, metal beds previously cleaned of all foreign materials. Truck beds may be lined with a polyethylene type material designed and installed for hauling hot bituminous mixes. Each load shall be covered with canvas or other suitable material of sufficient size and thickness to retain heat and to protect it from weather conditions. The cover material when new shall weigh a minimum of 0.6 kg/m² (18 oz/yd²) and it shall be a tightly woven or solid material. The inside surfaces of vehicles may be lightly lubricated with a thin oil film or soap solution, but an excess of lubricant will not be permitted. When necessary, so that the mixture can be delivered on the project at the specified temperature, truck beds shall be insulated, and covers shall be securely fastened. Equipment that leaks oil, diesel fuel, gasoline, or any other substance detrimental to the pavement will not be allowed on the project.

3.5 Placing.

3.5.1 Prior to placing of any mix, a pre-paving conference shall be held to discuss and approve the paving schedule, source of mix, type and amount of equipment to be used, sequence of paving pattern, rate of mix supply, traffic control, and general continuity of the operation. Special attention shall be made to the paving pattern sequence to minimize cold joints. The field supervisors of the above mentioned operations shall attend this meeting.

3.5.1.1 The Contractor shall notify the Engineer at least three working days in advance of paving operations to allow sufficient time to schedule required site inspection and testing. All paving and compaction equipment shall be approved and on site prior to start up each day.

3.5.1.2 Crack sealing material to be covered by a 25 mm (1 in.) or less overlay shall cure a minimum of 45 days prior to the placement of bituminous pavement.

3.5.1.3 When performing paving operations at night, in addition to the requirements of 3.1.2.5, the Contractor shall provide sufficient lighting at the work site to ensure the same degree of accuracy in workmanship and conditions regarding safety as would be obtained in daylight.

3.5.2 Weather limitations. Mixtures shall be placed only when the underlying surface is dry, frost free, and the surface temperature is above 5 °C (40 °F) for courses greater than 32 mm (1-1/4 in) in compacted depth and above 10 °C (50 °F) for courses less than 32 mm (1-1/4 in) in compacted depth. The Engineer may permit, in case of sudden rain, the placing of mixture then in transit from the plant, if laid on a base free from pools of water, provided motorist visibility is not impaired and all other specifications are met. No load shall be sent out so late in the day that spreading and compaction cannot be completed during the daylight, unless night work is specified. If rapid surface cooling of the laid down mix is occurring due to wind, the Engineer may suspend operations for the day. Wearing course shall not be scheduled for placement after October 1st of any year without written approval by the Engineer. If it is determined to be in the best interest of the Department to schedule placement after October 1st, the above specified weather and surface conditions shall remain in effect.

3.5.2.1 In special instances, when the Engineer determines that it is in the best interest of the State, the Engineer may waive the requirements of 3.5.2.

3.5.2.2 Any material delivered to the spreader having a temperature lower than 120 °C (250 °F) shall not be used.

3.5.3 At the beginning and end of the project or project section, the existing pavement shall be removed to a sufficient depth to allow the placing of the new pavement and construction of a transverse joint, which shall be painted with a suitable bituminous material. The underlying course shall be clean and free from foreign materials and loose bituminous patches and must present a dry, unyielding surface.

3.5.4 Sweeping. Existing pavement or previously laid courses shall be thoroughly dry and free from all dust, dirt, and loose material. Sweeping with a power broom, supplemented by hand brooming, may be necessary.

3.5.5 Tack coat. Surfaces of any pavement course shall have a tack coat of emulsified asphalt applied in accordance with the requirements of 410.3.4.2 and 410.3.4.2.1.

3.5.6 Drainage and utility structures within the limits of the pavement shall be set and raised in accordance with the provisions of 604.3.4. Contact surfaces of the drainage and utility castings as ordered shall be painted with a thin coating of suitable bituminous material.

3.5.7 All courses shall be spread and finished to the required thickness by approved, self-contained, self-propelled spreading and finishing machines (pavers). Pavers shall be provided with an adjustable, activated screed and shall be capable of spreading the mixtures with a finish that is smooth, true to the required cross-section, uniform in density and texture, and free from hollows, tears, gouges, corrugations, and other irregularities. Broadcasting behind the paver shall be held to a minimum. Pavers shall be capable of spreading and finishing courses of the required thicknesses and lane widths. Horizontally oscillating strike-off assemblies will not be approved.

3.5.7.1 The activated screed shall be of the vibrating or tamping bar type or a combination of both and shall operate without tearing, shoving, or gouging the mixture. The activated portion of the screed shall extend the full width of the mixture being placed in the traveled way and other areas with sufficient width to accommodate a paver. In other locations as permitted such as narrow shoulders, tapers, and areas adjacent to curbs, nonactivated extensions to the screed will be allowed. The paver shall be equipped with a screed heater. The screed heater shall be used when starting a cold machine and for maintaining a suitable screed temperature when needed.

3.5.7.2 The paver hopper gates shall be adjusted to pass the correct amount of mix to the spreading screws so that the screws operate more or less continuously. The height of material shall be maintained at a constant level in front of the screed, to a point where approximately half of the auger shall be visible at all times.

3.5.7.3 Pavers shall be equipped with the following complement of automatic screed controls for each paver:

1. Two 9 m (30 ft) ski type devices (floating beams)
2. Two grade sensors
3. Two short skis (joint matchers)
4. Slope sensing control for transverse slope.

The sensors for either or both sides of the paver shall be capable of sensing grade from an outside reference line or from the surface using a ski type device and shall be capable of sensing transverse slope of the screed. The sensors shall provide automatic signals that operate the screed to maintain the desired grade and transverse slope. Pavers shall not be used until the automatic controls have been checked and approved by the Engineer.

3.5.7.4 The use of automatic grade and slope controls shall be required on all pavers.

3.5.7.5 Whenever a breakdown or malfunction of the automatic controls occurs, the equipment may be operated manually for the remainder of the normal working day on which the breakdown or malfunction occurred. This method of operation must meet all other specifications.

3.5.7.6 On projects or parts of projects where the Engineer deems that the use of automatic controls are impracticable, some or all of the controls listed in 3.5.7.3 may be waived.

3.5.8 The forward speed of the paver shall be adjusted to the rate of the supply of materials so that the paver operates without having to make stops except for emergencies. If the Engineer determines that the paving operations result in excessive stopping of the paver, the Engineer may suspend all paving operations until the Contractor makes arrangements to synchronize the rate of paving with the rate of delivery of materials.

3.5.9 When patching existing pavement, the material shall be placed on the prepared clean underlying surface at the locations designated and shall be spread to produce a smooth and uniform patch. The patch material shall be thoroughly compacted and shall match the line and grade of the adjacent pavement.

3.5.10 Relatively small areas not accessible to the paver may be spread by hand, but extreme care shall be taken to create a surface texture similar to the machine work. Surface material shall be spread by lutes and not by rakes.

3.5.11 Unless otherwise authorized, the final wearing course shall not be placed until guardrail posts have been set and general cleanup has been completed.

3.5.12 When hot bituminous bridge pavement is to be placed over barrier membrane, the placing temperature shall be as specified in 538.3.5. Unless otherwise permitted, the 25 mm (1 in) base course shall be placed within five days after the membrane has been completed. A paver, mounted on rubber tracks or tires, shall be used to place the 25 mm (1 in) base course unless this procedure is found to cause damage to the membrane. When such damage is found to be evident, the hand method may be allowed. The hand method may also be allowed if the Engineer determines that the use of a paver for this work is impracticable. During warm weather, the above paving shall be done during the cool period of the day. A paver shall be used to place the wearing course.

3.5.13 Where pavement is placed adjacent to structural members such as expansion joints, the material in the top course shall be placed so that the compacted grade of the pavement is 6 to 13 mm (1/4 to 1/2 in) above the grade of the structural member.

3.6 Compaction.

3.6.1 Immediately after the bituminous mixture has been spread, struck off, and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling. The initial rolling shall be done with a static or vibratory steel-drum roller. Intermediate rolling shall be done by a pneumatic-tired roller. Final rolling shall be done with a static steel-drum roller or a roller of the steel-drum three-axle type, locked. Rollers must be in good mechanical condition, free from excessive backlash, faulty steering mechanism, or worn parts. The empty weight and the ballasted weight shall be properly marked on each roller. The minimum weight of static steel-drum rollers shall be 7.3 metric tons (8 tons). When a vibratory roller is being used, the vibration shall stop automatically when the roller is stopped or reversing direction of travel.

3.6.2 Pneumatic-tire rollers shall be self-propelled and shall be equipped with smooth tires of equal size and diameter. The wheels shall be so spaced that one pass of a two-axle roller accomplishes one complete coverage. The wheels shall not wobble and shall be equipped with pads that keep the tires wet. The rollers shall provide an operating weight of not less than 900 kg (2,000 lb) per wheel. All tires shall be maintained at a uniform pressure between 380 and 620 kPa (55 and 90 psi) with a 35 kPa (5 psi) tolerance between tires. A suitable tire pressure gauge shall be readily available.

3.6.3 Unless otherwise directed, rolling shall begin at the sides and proceed longitudinally parallel to the roadway center line, gradually progressing to the crown of the roadway. The overlap shall be one-half the roller width for wheeled rollers and 150 mm (6 in) for vibrating rollers. No overlap is required for pneumatic-tired rollers. When paving in echelon or abutting a previously placed lane, the longitudinal joint shall be rolled first followed by the regular rolling procedure. On superelevated curves, the rolling shall begin at the low side and progress to the high side by overlapping of longitudinal passes parallel to the centerline.

3.6.4 Rollers shall move at a slow but uniform speed with the drive roll or drive wheels nearest the paver, except on steep grades. Static and pneumatic-tired rollers shall not operate at speeds in excess of 10 km/h (6 mph). Base courses shall be rolled until all roller marks are eliminated. The wearing course shall be rolled until all roller marks are eliminated and a minimum density of 95 percent of laboratory specimens, made by the AASHTO T 245 method in the proportions of the job mix formula, has been obtained. When ordered by the Engineer, nuclear tests may be taken at the beginning of the wearing course construction to establish the correct rolling patterns that will achieve the required density.

3.6.5 Any displacement occurring as a result of reversing the direction of a roller, or from other causes, shall be corrected at once by the use of lutes and the addition of fresh mixture when required. Care shall be exercised in rolling so as not to displace the line and grade of the edges of the bituminous mixture.

3.6.6 To prevent adhesion of the mixture to the rollers, the wheels shall be kept properly moistened with water or water mixed with very small quantities of detergent or other approved material. Excess liquid will not be permitted. All steel rollers shall be equipped with adjustable wheel scrapers.

3.6.7 Along forms, curbs, headers, and similar structures and other places not accessible to a normal full-sized roller, sidewalk rollers weighing at least 900 kg (2,000 lb) shall be used. Where rollers are impracticable, the mixture shall be thoroughly compacted with heated or lightly oiled hand tamps or vibrating plate compactors.

3.6.8 Unless the Engineer determines that for the weight and placement conditions a lesser number will be satisfactory to obtain the desired pavement densities, the following is the list of required compaction equipment. The output of each paver placing base course or wearing course (Table 2) materials shall be compacted by the use of one each of the following complement of rollers as a minimum: a static or vibratory steel-drum roller, a pneumatic-tired roller and followed in either case by a static steel-drum roller or three-axle steel-drum roller. If the required density is not being obtained with the rollers supplied, the use of additional rollers of the specified type may be ordered. Paving widths in excess of 5 m (16 ft) will require additional rollers as ordered.

3.7 Joints.

3.7.1 The first lane placed shall be true to line and grade and shall be trimmed by hand to a stringline if necessary to obtain a true longitudinal joint. Material not trimmed away shall be packed against the lane by means of lutes, leaving a uniform joint with a vertical or nearly vertical face. Outside joints in subsequent lanes shall be similarly trued, as directed. Unless otherwise shown on the plans, the longitudinal wearing course joint shall be in the center of the pavement, and joints of other courses shall be offset approximately 150 mm (6 in).

3.7.2 The material being placed next to a previously paved lane shall be tightly crowded against the face of the abutting lane. The finishing machine shall be positioned so that during spreading, the material will overlap the edge of the first lane by 25 to 50 mm (1 to 2 in) and shall be left sufficiently high to match the previously paved lane after compaction. The overlapped material shall be crowded to the joint with a lute prior to rolling.

3.7.3 Placing of the course shall be as continuous as possible while complying with Contract Traffic Control Plans. Transverse joints will be allowed at the end of each work shift or as required to provide properly bonded longitudinal joints.

3.7.3.1 No longitudinal joints greater than 20 mm (3/4 inch) in height shall be left open to traffic unless a tapered overlapping (“wedge”) joint is used.

3.7.3.2 Unless otherwise precluded by weather conditions, longitudinal joints shall not remain open to traffic longer than 30 hours.

3.7.4 If a bulkhead is not used to form the transverse joint, the previously laid material shall be cut back to the designed slope and grade of the course. The joint face shall be coated with approved bituminous material before the fresh mixture is placed against it. Extreme care shall be taken to ensure that no unevenness occurs at the joint. If unsatisfactory riding qualities are obtained at the transverse joint in the wearing course, the joint shall be corrected by an approved method.

3.7.4.1 Prior to opening any lane(s) to traffic, transverse joints shall be ramped by means of an asphalt fillet at a minimum of 1.5 m (5 feet) horizontal to 25 mm (1 inch) vertical slope.

3.7.5 An approved bituminous material shall be applied to all joint contact surfaces unless a properly bonded joint is provided as specified in 3.7.6.3.

3.7.6 A tapered overlapping (“wedge”) joint may be used on all longitudinal joints provided that the adjacent lane can be placed when the existing surface temperature is above 10 °C (50 F).

3.7.6.1 An inclined face (3:1) on the joint shall be formed in the first bituminous mat placed. The inclined face may be for the entire height or an inclined face with a 13 mm (1/2 in) maximum vertical face at the top of the mat.

3.7.6.2 After the initial mat is placed, the mat shall be rolled to the edge of the unconfined face.

3.7.6.3 When the adjoining mat is placed the initial longitudinal wedge shall be either treated with an approved bonding agent or heated to a temperature that facilitates bonding of the joint with an approved heating device.

3.7.6.4 Luting the joint after placement of the second mat will not be required unless necessary to correct surface irregularities.

3.8 Surface Tolerances.

3.8.1 The Contractor shall furnish and have available a 3 m (10 ft), light-weight metal straightedge with a rectangular cross-section of 50 by 100 mm (2 by 4 in) at the paver at all times during paving operations. All courses shall be tested with the straightedge laid parallel to the centerline and any variations from a true profile exceeding 5 mm (3/16 in) shall be satisfactorily eliminated. The finished surface of the pavement shall be uniform in appearance, shall be free from irregularities in contour, and shall present a smooth-riding surface.

3.9 Replacement.

3.9.1 If unsatisfactory areas are found in any course, the Contractor shall remove the unsatisfactory material and replace it with satisfactory material after coating the exposed edges with suitable bituminous material.

3.10 Application of Requirements.

3.10.1 Except as specifically noted, these construction requirements shall apply equally to all courses.

3.11 Finished Appearance.

3.11.1 Any bituminous material remaining on exposed surfaces of curbs, sidewalks, or other structures shall be removed.

Method of Measurement

4.1 Plant mix bituminous pavement mixture will be measured by the metric ton (ton) to the nearest 0.1 metric ton (0.1 ton), and in accordance with 109.01. Batch weights will be permitted as a method of measurement only when the provisions of 3.4.3 are met, in which case, payment will be based on the cumulative weight of all the batches. The quantity will be the weight used in the accepted pavement, and no deduction will be made for the weight of bituminous material or additives in the mixture.

4.1.1 Due to possible variations in the specific gravity of the aggregates, and to possible field changes in areas to be paved, the quantity used may vary from the proposal quantities, and no adjustment in contract unit price will be made because of such variations.

4.2 Plant mix bituminous pavement, removed because of faulty workmanship or contamination by foreign materials, will not be included in the pay quantity.

4.3 Hot bituminous bridge pavement, base course of the depth and additional materials specified will not be measured, but shall be the metric ton (ton) final pay quantity in accordance with 109.11 for compacted material within the limits shown on the plans.

Basis of Payment

5.1 All work performed and measured as prescribed above will be paid for as provided in the respective sections for each type specified.

5.2 Tack coat material ordered under 3.5.5 will be subsidiary to the paving items.

5.3 Approved bituminous material ordered for the coating of contact surfaces and joints as specified will be subsidiary.

5.4 Plant or project lighting, or overtime required due to night operations will be subsidiary to the paving items.

5.5 Asphalt cement additives will be subsidiary to the paving items.

SECTION 403 -- HOT BITUMINOUS PAVEMENT**Description**

1.1 This work shall consist of constructing one or more courses of bituminous pavement on a prepared base as shown on the plans or as ordered. The methods may be classified as hand or machine.

1.1.1 Hand method shall include only the paving of raised islands, slopes, cattle passes, areas between rails at railroad crossings, existing sidewalks, drives, drive aprons, curb patch between concrete barrier and pavement, curb patch between granite curb and pavement, and paving of 45 metric tons (50 tons) or less added after the completion of paving operations.

1.1.2 Machine method shall include all paving not classified as hand method.

Materials

2.1 Materials and their use shall conform to the requirements of 401.2.

2.2 When single course pavement is constructed, the required grading shall conform to 401, Table 2, single course, Type D.

2.3 Temporary bituminous pavement shall also conform to 401, Table 2. Thickness shall be as shown on the plans or as ordered by the Engineer.

Construction Requirements

3.1 Construction requirements shall be as prescribed in 401.3.

3.2 For temporary pavement only, amend portions of 401.3.6 as follows:

3.2.1 The requirements of 401.3.6.1 shall apply except rolling may be accomplished with a dual vibrating steel drum roller.

3.2.2 Delete 401.3.6.2.

3.3 For temporary bituminous pavement only delete 401.3.8.

3.4 Temporary bituminous pavement shall be removed when no longer needed.

Methods of Measurement

4.1 Hot bituminous pavement will be measured as prescribed in 401.4.

Basis of Payment

5.1 The accepted quantities of hot bituminous pavement will be paid for at the contract price per metric ton (ton) for the bituminous mixture, complete in place.

5.2 Bridge wearing course will be paid under machine method.

5.3 Single course pavement will be paid under either machine or hand method as prescribed in 1.1.

5.4 Hot bituminous bridge pavement, base course of the depth and additional materials specified is a final pay quantity item and will be paid for at the contract unit price per metric ton (ton) in accordance with 109.11.

5.5 The accepted quantity of temporary bituminous pavement will be paid for at the contract unit price per metric ton (ton) complete.

5.5.1 Removal of the temporary pavement will not be paid for under other items of the contract but will be subsidiary.

Pay items and units:

403.11	Hot Bituminous Pavement, Machine Method	Metric Ton (Ton)
403.119	Hot Bituminous Pavement, Machine Method (Night)	Metric Ton (Ton)
403.1199	Hot Bituminous Pavement, Machine Method, High Strength (Night)	Metric Ton (Ton)
403.12	Hot Bituminous Pavement, Hand Method	Metric Ton (Ton)
403.129	Hot Bituminous Pavement, Hand Method (Night)	Metric Ton (Ton)
403.351	Hot Bituminous Pavement, Aggregate 35 percent Wear, Machine Method	Metric Ton (Ton)
403.3519	Hot Bituminous Pavement, Aggregate 35 percent Wear, Machine Method (Night)	Metric Ton (Ton)
403.352	Hot Bituminous Pavement, Aggregate 35 percent Wear, Hand Method	Metric Ton (Ton)
403.51	Hot Bituminous Pavement, Aggregate 50 percent Wear, Machine Method	Metric Ton (Ton)
403.519	Hot Bituminous Pavement, Aggregate 50 percent Wear, Machine Method (Night)	Metric Ton (Ton)
403.52	Hot Bituminous Pavement, Aggregate 50 percent Wear, Hand Method	Metric Ton (Ton)
403.529	Hot Bituminous Pavement, Aggregate 50 percent Wear, Hand Method (Night)	Metric Ton (Ton)
403.98	Hot Bituminous Concrete Leveling, Machine Method	Metric Ton (Ton)
403.99	Temporary Bituminous Pavement	Metric Ton (Ton)

Pay items and units (Metric):

403.911	Hot Bituminous Bridge Pavement, 25 mm Base Course (F)	Metric Ton
403.91109	Hot Bituminous Bridge Pavement, 25 mm Base Course (Night) (F)	Metric Ton
403.9115	Hot Bituminous Bridge Pavement, 25 mm Base Course, Aggregate 50 Percent Wear (F)	Metric Ton

Pay items and units (English):

403.911	Hot Bituminous Bridge Pavement, 1 in Base Course (F)	Ton
403.91109	Hot Bituminous Bridge Pavement, 1 in Base Course (Night) (F)	Ton
403.9115	Hot Bituminous Bridge Pavement, 1 in Base Course, Aggregate 50 Percent Wear (F)	Ton

SECTION 404 -- RECYCLED BITUMINOUS PAVEMENT**Description**

1.1 This work shall consist of constructing one or more courses of hot bituminous pavement on a prepared base or an existing pavement using a combination of virgin and salvaged material.

Materials

2.1 The salvaged hot bituminous pavement should be free from objectionable matter and shall be reduced in size so that when combined with the virgin aggregate, the final mixture shall conform to the gradation requirements as shown in 401, Table 1 for the composition type being produced. Salvaged hot bituminous pavements having significantly different gradations shall be stockpiled separately.

2.1.1 Residual moisture content in salvaged hot bituminous pavement shall be held to a practical minimum by covering it with an acceptable waterproof sheeting.

2.1.2 Virgin aggregate material shall meet the requirements of 401.2.1 through 401.2.1.4.

2.2 Bituminous materials shall meet the requirements of AASHTO M 226 except for those values shown in 702, Table 2. The grade to be used will be as designated by the Engineer.

2.3 The appropriate sections of 401.2.3, 401.2.4, and 401.2.7 shall apply.

2.3.1 The job mix formula shall include the proposed proportions of each material including the salvage material, asphalt modifier, if used, and new asphalt cement.

2.4 The asphalt modifier (recycling agent) shall be a softening agent, flux oil, rejuvenator, or soft asphalt cement conforming to the following:

Test	Requirements	
	Minimum	Maximum
Viscosity, 60 °C, Pa · s	5	35
Flash Point, COC, °C	230	
Saturates, percent		30
Thin-Film Oven Test		
Loss of Heating, percent		3
Viscosity Ratio, 60 °C		4

Test	Requirements	
	Minimum	Maximum
Viscosity, 140 °F, Poises	50	350
Flash Point, COC, °F	450	
Saturates, percent		30
Thin-Film Oven Test		3
Loss of Heating, percent		
Viscosity Ratio, 140 °F		4

Construction Requirements

3.1 The construction requirements shall be the same as those specified under 401.3.1 through 401.3.11 except as modified or supplemented hereinafter.

3.1.1 The plant shall be equipped so as to ensure a positive control of the feeding of salvaged material directly to the weigh hopper or to the drum mixer. The feeding system shall have the capability of delivering the exact amount of required material. If automation is used, this system shall be incorporated into the automatic cycle.

3.2 The maximum aggregate temperature as shown in 401.3.2.1 shall be deleted. The Engineer may require adjustment to the mixing time shown in 401.3.2.1.

3.3 The Engineer may approve or require the addition of a modifying or recycling agent to the asphalt prior to delivery of the asphalt to the project or during proportioning or mixing operations.

Method of Measurement

4.1 The provisions of 401.4.1 shall apply.

4.2 Asphalt modifier material will be measured to the nearest kilogram (pound).

Basis of Payment

5.1 The accepted quantities of recycled hot bituminous pavement, when used, will be paid for according to 403.5.1 and will be paid for separately.

5.2 The accepted quantities of asphalt modifier material will be paid for at the contract price per kilogram (pound).

Pay item and unit:

404.21	Recycled Hot Bituminous Pavement	Metric Ton (Ton)
404.31	Asphalt Modifier Material	Kilogram (Pound)

SECTION 410 -- BITUMINOUS SURFACE TREATMENT

Description

1.1 This work shall consist of preparing and applying one or more prime or seal coats of bituminous material to a gravel or stone course. This work shall also consist of a tack coat applied to a bituminous concrete surface or a portland cement concrete surface.

Materials

2.1 Bituminous material shall be the type and grade specified or ordered and shall conform to the requirements of AASHTO M 140 or M 208.

2.2 Blotter material shall be natural sand composed of hard, durable particles, free from loam, showing uniform resistance to abrasion. Gradation shall conform to 520, Table 2.

Construction Requirements

3.1 Limitations. Bituminous material shall not be applied on a wet surface, or when weather conditions would prevent the proper application and curing of the coat. The quantities, rate of application, temperatures, and areas to be treated shall be approved before application of bituminous material.

3.2 Equipment. Equipment required for this work shall be as follows:

(a) A distributor shall be so designed, equipped, maintained, and operated such that bituminous material at even heat may be applied uniformly on variable widths of surface up to 7.2 m (24 ft), at readily determined and controlled rates from 0.09 to 9 L/m² (0.02 to 2.0 gal/yd²), with uniform pressure, and with an allowable variation from any specified rate not to exceed 0.08 L (0.02 gal). Distributor equipment shall include a tachometer, pressure gauges, accurate volume measuring devices or a calibrated tank, and a thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a power unit for the pump and with full circulation spray bars adjustable laterally and vertically. The spray bar shall contain spray nozzles providing a fan-shaped spray pattern adjusted so the vertical axis is perpendicular to the pavement surface. The spray pattern and spray bar height shall be adjusted to provide a uniform

application of the tack coat without double coverage. The distributor shall be equipped with a mechanical device to adjust the spray height as material is discharged to keep a uniform height above the pavement for full coverage without overlapping. The distributor shall also be equipped with a hand-held spray attachment for applying the material to areas inaccessible to spray bars and to fill in irregular areas to provide full coverage. Approved sampling valves shall be installed in distributors and transport tank trucks to permit taking representative samples of the contents. The recommended location of the sampling valve is in the rear bulkhead of the tank roughly one-third of the height above the bottom. The inlet pipe shall project into the contained liquid as shown in AASHTO T 40. At least 1 L (1 qt) of material shall be drained off through the sampling valve and discarded before the desired sample is taken. New sample containers will be furnished by the Engineer. To prevent the loss of solvents, containers shall be sealed with a tight fitting cover immediately after being filled.

- (b) A rotary power broom for sweeping treated surface.
- (c) A steel-wheeled roller.
- (d) A self-propelled pneumatic-tired roller.
- (e) A sand spreader capable of spreading blotter material in sufficient quantity to prevent traffic pickup of the applied bituminous material.
- (f) A steel-brush drag of an approved type.

3.3 Preparation of Surface to be Treated.

3.3.1 Prime coat. The surface to be primed shall be shaped to the required grade and section, shall be free from all ruts, corrugations, segregated material, or other irregularities, and shall be uniformly compacted in accordance with 304.3.6.

3.3.1.1 Immediately before applying the prime coat, the surface shall be loosened slightly by dragging with a steel-brush drag.

3.3.2 Tack coat. The existing surface shall be patched and shall be free of irregularities to provide a reasonably smooth and uniform surface to receive the treatment. Unstable corrugated areas shall be removed and replaced with suitable patching materials. The edges of existing pavements that are to be adjacent to new pavement shall be cleaned to permit the adhesion of bituminous materials.

3.4 Application of Bituminous Material.

3.4.1 Prime coat. Bituminous material shall be applied to the width of the section to be primed by means of a pressure distributor in a uniform, continuous spread. When traffic is maintained, not more than one-half of the width of the section shall be treated in one application. Care shall be taken that the application of bituminous material at junctions is not in excess of the specified amount. Excess material shall be squeegeed from the surface. Skipped areas or deficiencies shall be corrected.

3.4.1.1 When traffic is maintained, one-way traffic shall be permitted on the untreated portion of the roadbed. As soon as the bituminous material has been absorbed by the surface and no longer picks up, traffic shall be transferred to the treated portion, and the remaining width of the section shall be primed.

3.4.2 Tack coat. Bituminous material shall be uniformly applied with an approved applicator. When ordered, a pressure distributor shall be used. The tack coat shall be applied in such a manner as to offer the least inconvenience to traffic and to permit one-way traffic without pickup or tracking of the bituminous material.

3.4.2.1 A tack coat shall be applied immediately prior to placement of pavement. The rate of application of emulsified asphalt shall be between 0.09 and 0.23 L/m² (0.02 and 0.05 gal/yd²), as determined by the Engineer depending on the relative absorbance and texture of the pavement surface.

3.5 Application of blotter material. If, after the application of the prime coat, the bituminous material fails to penetrate within the time specified and the roadway must be used by traffic, blotter material shall be spread in the amounts required to absorb any excess bituminous material. Care shall be taken not to cover a 150 mm (6 in) strip next to the centerline of the roadway until the untreated area has received the first application of bituminous material.

3.5.1 When the entire width of the surface has been treated with bituminous material and blotter material, it shall be dragged with a steel-brush drag. The surface shall be brushed only the amount necessary to distribute the blotter material uniformly.

3.5.2 When ordered, the entire treated surface shall be rolled until the materials are thoroughly bonded.

3.5.3 Sufficient extra blotter material shall be applied whenever necessary to prevent traffic and the roller from picking up the bituminous material.

3.5.4 Additional brush dragging may be required to keep the blotter material uniformly distributed until the bituminous material is thoroughly cured.

3.5.5 The primed surface shall be kept in repair. All holes, ravels, and deficient areas shall be patched and repaired with bituminous treated materials, as approved.

3.5.6 When the bituminous material is thoroughly cured, blotter material remaining on the treated area shall be removed by sweeping with an approved power broom. This operation must be accomplished before subsequent application of any seal coat.

3.6 Seal Coat.

3.6.1 When directed, a seal coat shall be applied at the rate in liters per square meter (gallons per square yard) specified on the plans or as ordered, and by the same method as the prime coat.

3.6.2 Blotter material at the rate ordered shall be applied before the bitumen has set; the entire treated surface shall be dragged, rolled and maintained. The remaining blotter material shall be removed, all by the same methods as specified for the prime coat.

3.7 Finished Appearance.

3.7.1 Any bituminous material splashed or sprayed onto exposed surfaces of curbs, sidewalks, or other masonry structures shall be removed by sandblasting at the Contractor's expense.

Method of Measurement

4.1 Bituminous material will be measured by the metric ton or kilogram (ton or pound), and in accordance with 109.01. Measurements by the metric ton (ton) will be made to the nearest 0.1 metric ton (0.1 ton) and by the kilogram (pound) to the nearest kilogram (pound).

4.2 Blotter material furnished will be subsidiary.

Basis of Payment

5.1 The accepted quantities of bituminous surface treatment will be paid for at the contract price per metric ton or kilogram (ton or pound) for bituminous material, complete in place.

5.2 Payment for patching existing pavements under 3.3.2 will be made at the contract unit price for Item 403.11 or Item 411.1, as ordered.

5.3 Emulsified asphalt for tack coat required under 401.3.5.5 will be subsidiary to the paving items.

Pay items and units:

410.21	Emulsified Asphalt for Tack Coat	Metric Ton (Ton)
410.22	Emulsified Asphalt for Tack Coat	Kilogram (Pound)
410.31	Asphalt Surface Treatment	
	Including Blotter Material	Metric Ton (Ton)
410.41	Emulsified Surface Treatment	
	Including Blotter Material	Metric Ton (Ton)

SECTION 411 -- PLANT MIX SURFACE TREATMENT

Description

1.1 This work shall consist of a leveling course when ordered and one or more courses of bituminous mixture constructed on an existing pavement.

Materials

2.1 Materials and their use shall conform to the requirements of 401.2 as amended below:

2.1.1 Bituminous materials for mixtures shall be asphalt cement, or asphalt emulsion as specified. Unless otherwise ordered, the grade shall be as specified below:

2.1.1.1 Asphalt binder (cement) PG grade to be used for a particular project will be specified in a Special Provision contained in the Proposal.

2.1.1.2 Asphalt emulsion shall be HFMS-2 and conform to the requirements of 702, Table 2.

1.1.2 Unless otherwise directed, the composition of the mixtures shall fall within the limits of the master ranges set forth in Table 1 or Table 2 as appropriate.

**Table 1 - Composition of Mixture - Master Ranges
Leveling Course**

Sieve Size	Percentage by Weight Passing		
	Minimum	Desired	Maximum
9.5 mm (3/8 in.)	96	100	---
4.75 mm (No. 4)	75	75	---
2.39 mm (No. 8)	57	62	69
1.18 mm (No. 16)	38	47	55
0.600 mm (No. 30)	22	30	38
0.300 mm (No. 50)	11	16	21
0.150 mm (No. 100)	5	8	11
0.075 mm (No. 200)	2	4	6
Asphalt Cement: % of Total Mix	6.25	6.7	7.25

**Table 2 - Composition of Mixtures - Master Ranges
Plant Mixed Surface Treatment**

Sieve Size	10 mm (3/8 in)			16 mm (5/8 in)			19 mm (3/4 in)		
	Percentage by Weight Passing								
	Min	Desired	Max	Min	Desired	Max	Min	Desired	Max
9.5 mm (3/8 in)	--	--	--	--	100	--	95	100	--
4.75 mm (No. 4)	--	100	--	85	92	100	70	77	84
2.36 mm (No. 8)	75	85	93	68	77	87	54	60	65
1.18 mm (No. 16)	54	65	74	49	59	69	35	42	51
0.600 mm (No. 30)	34	45	55	30	39	49	20	28	36
0.300 mm (No. 50)	18	26	35	15	21	29	10	15	20
0.150 mm (No. 100)	6	11	16	6	10	15	4	8	11
0.075 mm (No. 200)	2	4	6	2	4	6	2	4	6
	Percentage of Total Mix								
Asphalt Cement	---	---	---	6.5	7.0	7.5	6.25	6.7	7.25
Asphalt Cutback	6.5	7.0	7.5	6.5	7.0	7.5	---	---	---

2.1.3 When permitted, asphalt cement may be substituted for asphalt emulsion.

2.1.4 Blotter materials shall be sand conforming to the requirements of Table 3.

Table 3 -- Blotter Material

Sieve Size	Percent by Weight Passing
4.75 mm (No. 4)	100
2.00 mm (No. 10)	70 - 92
0.075 mm (No. 200)	0 - 6

Construction Requirements

3.1 Mixing plants shall be as prescribed in 401.3.1, except that the second sentence of 401.3.1.6.5 will not apply for plants producing plant mix surface treatment. A 4.75 mm (3/16 in) screen will be required in preparing the aggregate for the 9.5 mm (3/8 in) course. However, the Administrator of the Bureau of Materials and Research may waive this requirement when small quantities are involved.

3.2 Mixing and storage shall conform to 401.3.1.6.11, 401.3.2, and 401.3.3 with the following modifications:

3.2.1 The temperature of the asphalt emulsion shall be 50 to 70 °C (120 to 160 °F). The temperature of the mixture in the truck shall be 100 to 110 °C (210 to 230 °F).

3.2.2 If the aggregate contains sufficient moisture to cause foaming in the mixture, it shall be removed from the bins. The quantity of cold aggregate fed to the dryer shall be governed by the ability of the dryer to completely remove the moisture from the aggregate, as determined by the Engineer.

3.3 Weighing and hauling shall conform to 401.3.4

3.4 Placing shall conform to 401.3.5 with the following modifications:

3.4.1 The existing pavement shall be thoroughly dry and free from all dust, dirt, and loose material. Sweeping with a power broom supplemented by hand brooming may be required.

3.4.2 Existing pavement shall be treated with tack coat as prescribed in 410.3.4.2. When ordered, the existing pavement shall be treated as prescribed in 410.3.3.

3.4.3 A leveling course of hot bituminous concrete may be ordered to prepare the pavement for the finish course.

3.4.4 Any material delivered to the spreader having a temperature lower than 95 °C (200 °F) for emulsion mixture or 120 °C (250 °F) for asphalt cement mixture shall not be used.

3.4.5 In those areas where the edges of the pavement are adjacent to paved or bituminous treated shoulders, the asphalt paving machine shall be equipped to produce a feathered edge, parallel to the direction of traffic, and a uniform longitudinal line shall be maintained at the outer edge of the applied pavement.

3.4.6 All bridges included within the limits of the work shall be treated curb to curb.

3.5 Compaction shall conform to 401.3.6 with the following modifications:

3.5.1 If necessary to prevent traffic pickup of the mixture, the surface of the work shall be given a light dusting of blotter material just prior to rolling with a pneumatic-tired roller. The surface shall be maintained thereafter by occasional back sanding and rolling as directed.

3.5.3 3.5.2 When more than 115 metric tons (125 tons) of mixture is being placed per hour, an additional steel-wheeled roller will be required.

3.5.3 Excess blotter material remaining on the pavement and on paved shoulders shall be removed prior to acceptance of the project.

3.5.4 After rolling has been completed, the edges of the pavement shall be trimmed as directed to secure a uniform line.

3.6 Only the last sentence of 401.3.8 shall apply to plant mix surface treatment.

Method of Measurement

4.1 Plant mix surface treatment will be measured as prescribed in 401.4.

4.2 Blotter material used on plant mix surface treatment will be subsidiary.

Basis of Payment

5.1 The accepted quantities of leveling course and plant mix surface treatment will be paid for at the contract unit price per metric ton (ton), complete in place.

5.1.1 Tack coat material required under 3.4.2 will be subsidiary to the leveling course and plant mix surface treatment items.

Pay items and units (Metric):

411.1	Hot Bituminous Concrete Leveling Course	Metric Ton
411.15	Hot Bituminous Concrete Leveling Course, Aggregate 50 Percent Wear	Metric Ton
411.19	Hot Bituminous Concrete Leveling Course (Night)	Metric Ton
411.410	Plant Mix Surface Treatment (Asphalt Cement), 10 mm	Metric Ton
411.413	Plant Mix Surface Treatment (Asphalt Cement), 13 mm	Metric Ton
411.419	Plant Mix Surface Treatment (Asphalt Cement), 19 mm	Metric Ton

Pay items and units (English):

411.1	Hot Bituminous Concrete Leveling Course	Ton
411.15	Hot Bituminous Concrete Leveling Course, Aggregate 50 Percent Wear	Ton
411.19	Hot Bituminous Concrete Leveling Course (Night)	Ton
411.43	Plant Mix Surface Treatment (Asphalt Cement), 3/8 in	Ton
411.44	Plant Mix Surface Treatment (Asphalt Cement), 1/2 in	Ton
411.46	Plant Mix Surface Treatment (Asphalt Cement), 3/4 in	Ton

SECTION 413 -- HOT-POURED CRACK SEALANT**Description**

1.1 This work shall consist of filling the major cracks in the pavement with an approved sealant material. The cracks to be filled will be those designated by the Engineer.

Materials & Equipment

2.1 Material shall be of the hot-poured type and be a product as included on the Qualified Products List.

2.1.1 Material not covered by an asphalt pavement overlay shall meet the requirements of AASHTO M 301 (ASTM D 3405).

2.1.2 Material covered by an asphalt pavement overlay shall be low modulus conforming to ASTM D 3405, modified.

2.2 Equipment shall meet the approval of the Engineer and shall be maintained in good working condition at all times.

(a) Air compressors shall be portable and capable of furnishing not less than 3.0 m³ (100 ft³) of air per minute at not less than 620 kPa (90 psi) pressure at the nozzle. The compressor shall be equipped with traps that maintain the compressed air free from oil and water.

(b) Hand tools shall consist of brooms, shovels, metal bars with chisel-shaped ends, and any other tools that may be required to accomplish the work.

(c) Melting kettles shall be of the double-boiler, indirect-fired, portable type. The space between the inner and outer shells shall be filled with a suitable heat transfer oil or substitute having a flash point of not less than 280 °C (530 °F). The kettle shall be equipped with a satisfactory means for agitating the joint sealer. This may be accomplished by continuous stirring with mechanically operated paddles or by a continuous circulating gear pump attached to the heating unit, or by both paddles and a pump. The kettle shall be equipped with a thermostatic

control calibrated between 95 and 290 °C (200 and 550 °F). The kettle shall be mounted on rubber tires and shall be equipped with a metal shield beneath the firebox to protect the pavement.

(d) Hand pouring pots shall be equipped with mobile carriages and rubber shoes and have flow control valves that allow all cracks to be filled to refusal.

(e) Routers for reshaping cracks shall be of the multiblade rotary cutter head type.

(f) Hot-air lances for blowing clean and drying cracks shall be an approved propane gas burner and compressed air device that does not allow the flame to touch the pavement.

(g) The wand applicator shall be connected to the holding tank through an applicator hose that ensures the safety of the operator and allows the operator to control the flow of material. A device shall be mounted to bypass material into the holding tank if the applicator nozzle is shut off.

Construction Requirements

3.1 All cracks greater than 3 mm (1/8 in) up to 19 mm (3/4 in) in width shall be shaped with a power router to a dimension of 19 mm (3/4 in) \pm 3 mm (1/8 in) wide by 15 mm (5/8 in) deep rectangular shape and treated unless otherwise directed. Cracks greater than 19 mm (3/4 in) shall be treated but not routed. Router bits will be maintained to ensure that rectangular dimensions are achieved. A rounded shape will not be allowed.

3.2 All cracks ordered treated shall be hot-air lance cleaned of dirt, foreign material, and loose edges.

3.3 The material removed from the cracks shall be removed from the roadway surface prior to reopening the roadway to traffic.

3.4 The hot-poured sealant shall be applied at the temperature specified by the manufacturer and approved by the Engineer.

3.5 The hot-poured sealant shall be applied to the cracks using hand pouring pots or wand applicators immediately following hot-air lance cleaning. Only wand applicators shall be used for crack filling when cracks are not covered by an asphalt pavement overlay.

3.6 All cracks to be treated shall be filled to 1 mm to 3 mm (1/16 in to 1/8 in) below the pavement surface with hot-poured sealant with the sealant left slightly concave. Filling flush, overfilling, and overbanding of cracks will not be allowed. Sealant shall tightly bond to the pavement. The sealant bond to the pavement shall be checked. If the sealant does not bond to the pavement, sealant shall be removed and crack sealing operations discontinued until debonding problem is corrected.

3.7 No hot-air lance cleaning or crack sealing shall be performed when the pavement and cracks are wet or the ambient temperature is below 10 °C (50 °F).

3.8 All work shall be performed in a neat manner. The sealant shall be allowed to cool sufficiently to prevent lifting, sticking, and tracking prior to returning the pavement segment to traffic.

Method of Measurement

4.1 Hot-poured crack sealant will be measured by the kilogram (pound) of material incorporated in the work.

Basis of Payment

5.1 The accepted quantity of hot-poured crack sealant will be paid for at the contract unit price per kilogram (pound), complete in place.

5.2 Cleaning and routing will be subsidiary.

Pay item and unit:

413.1	Hot-Poured Crack Sealant	Kilogram (Pound)
413.2	Hot-Poured Crack Sealant (Low Modulus)	Kilogram (Pound)
413.3	Polyester Reinforced Mastic Crack Treatment	Square Meter (Square Yard)

SECTION 417 -- COLD PLANING BITUMINOUS SURFACES

Description

1.1 This work shall consist of the removal of existing bituminous pavement, by planing or milling type equipment, to the depth and grade shown on the plans or ordered.

Equipment

2.1 Equipment used for planing of bituminous surfaces shall be a power-operated rotary planing or milling machine capable of uniformly removing the existing bituminous surfaces.

Construction Requirements

3.1 The existing bituminous surface shall be removed by a planing or milling machine capable of removing, in one or more passes, bituminous material to the depth specified. The equipment shall be capable of accurately establishing profile grades by an automatic grade control system referencing from either the existing pavement or from an established independent grade line.

3.1.1 The equipment shall have an effective means for controlling dust.

3.2 Material removed during this operation shall be transported and stockpiled for use or as directed.

3.3 When performing night operations, the Contractor shall provide sufficient lighting at the work site to ensure the same degree of accuracy in workmanship and conditions regarding safety as would be obtained in daylight.

Method of Measurement

4.1 Cold planing bituminous surfaces will not be measured, but shall be the square meter (square yard) final pay quantity in accordance with 109.11 for surface area(s) where bituminous material is removed within the limits shown on the plans.

4.1.1 The nominal depth of material removed will be as shown on the plans.

Basis of Payment

5.1 Cold planing bituminous surfaces and cold planing bituminous surfaces (night) are final pay quantity items and will be paid for at the contract unit price per square meter (square yard) in accordance with 109.11.

5.1.1 Project lighting or overtime required due to night operations will be subsidiary to the cold planing.

Pay item and unit:

417.	Cold Planing Bituminous Surfaces (F)	Square Meter (Square Yard)
417.19	Cold Planing Bituminous Surfaces (Night) (F)	Square Meter (Square Yard)